

NATURAL RESOURCES CONSERVATION SERVICE  
CONSERVATION PRACTICE STANDARD

GRASSED WATERWAY

(Acre)

CODE 412

**DEFINITION**

A natural or constructed channel that is shaped or graded to required dimensions and established with suitable vegetation.

**PURPOSES**

This practice may be applied as part of a conservation management system to support one or more of the following purposes:

- ◆ to convey runoff from terraces, diversions, or other water concentrations without causing erosion or flooding.
- ◆ to reduce gully erosion.
- ◆ to protect/improve water quality.

**CONDITIONS WHERE PRACTICE APPLIES**

In areas where added water conveyance capacity and vegetative protection are needed to control erosion resulting from concentrated runoff and where such control can be achieved by using this practice alone or combined with other conservation practices.

**CRITERIA**

**General Criteria Applicable to All Purposes**

Grassed waterways shall be planned, designed, and constructed to comply with all Federal, State, and local laws and regulations.

Waterways shall be designed to safely transport runoff without causing erosion in the channel. Waterways shall not be cut too deep as to expose poor soils or other undesirable

materials, unless suitable compacted topsoil is placed in the channel to enable vegetation to be established.

Grassed waterways shall be designed by the most applicable of the following three methods: (1) individual waterway design, (2) minimum waterway design, or (3) ephemeral shaping.

**INDIVIDUAL WATERWAY DESIGN**

This design method shall be used for all grassed waterways that do not meet the minimum waterway design conditions, ephemeral shaping conditions or at the discretion of the designer.

**Capacity.** The minimum capacity shall be that required to convey the peak runoff expected from a 10-year frequency, 24-hour duration storm. Minimum capacity shall be increased as needed to account for potential volume of sediment expected to accumulate in the waterway during the planned useful life of the waterway (minimum of 10-year lifespan) unless sediment will be removed as part of a regular operation and maintenance program.

When there is a hazard potential from out of channel flow, minimum capacity will be increased beyond the design capacity to contain the frequency of storm desired based on the hazard potential as defined in the NRCS National Engineering Manual Part 503.

When the waterway slope is less than 1 percent, minimum capacity can be reduced to contain the peak runoff from a smaller frequency storm, if out of channel flow will not cause excessive erosion or vegetation/crops are not damaged from flooding.

**Velocity.** Design velocity shall not exceed those obtained by using the procedures, "n"

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values, and recommendations in the NRCS Engineering Field Handbook (EFH) Part 650, Chapter 7, Exhibits 7-2 and 7-3, or Agricultural Research Service (ARS) Agricultural Handbook 667, Stability Design of Grass-lined Open Channels. Maximum permissible velocities that are based on EFH Part 650 Chapter 7 are shown in Table 1. Maximum velocity in the waterway channel shall not exceed what is recommended for annual cover crops (Refer to Table 1), unless measures that effectively prevent channel erosion are installed. These measures can include; use of sidedikes to temporarily divert runoff from outside of the waterway until perennial vegetation is well established, mulching according to Mulching (484) standard immediately after grass seeding, lined waterways with stone/rock centers, or sodding all or a portion of the waterway likely to erode. Other practices such as cover crops (companion cover crops and/or cover crops prior to seeding grass), staked straw/hay bale dams across the channel, or filter fences can be utilized in conjunction with the above practices to expedite vegetation establishment.

Designs based on EFH, Part 650, Chapter 7 procedures shall use the following criteria:

- The design velocity for stability shall be based on “D” or “E” retardance as appropriate based on maximum velocity allowed in the waterway channel per above guidance (refer to Table 1).
- The design velocity for capacity shall be based on “B”, “C” or “D” retardance as appropriate based on final cover anticipated.

**Table 1. Maximum Permissible Velocity in Waterway Channel** (based on EFH Part 650 Chapter 7 Exhibit 7.3)

Cover	1/ Waterway Slope Range	2/ Erosion resistant soils (ft/s)	3/ Easily eroded soils (ft/s)
Grass Mixtures (well- established)	<5%	5 ft/s	4 ft/s
Grass Mixtures (well- established)	5-10%	4 ft/s	3 ft/s
4/ Annual Cover Crop	<5%	3.5 ft/s	2.5 ft/s

1/ Waterway slopes greater than those listed above are not stable based on the velocity and type of vegetation listed. Alternative practices/measures such as lined waterways (stone/rock centered), diversions, underground outlets, sediment basins, ephemeral shaping (7-acre or less drainage) or other measures are recommended to stabilize concentrated flow/ephemeral gully erosion when slopes are steeper than shown in this table.

2/ Cohesive (soils that contain clay) fine-grain soils and coarse-grain soils with cohesive fines with a plasticity index of 10-40 (CL, CH, SC, and CG)

3/ Soils that do not meet requirements for erosion-resistant soils.

4/ Annual cover crops such as narrow row/drilled sorghum sudan, sudan grass, cane or small grains that are used as temporary protection until permanent cover is established.

**Width.** Refer to EFH, Part 650 Chapter 7 for detailed guidance when designing and determining the width of parabolic or trapezoidal waterways. Trapezoidal waterways shall not exceed 40 feet bottom width unless multiple or divided waterways or other means are provided to control meandering of low flows.

**Side slopes.** Side slopes shall not be steeper than a ratio of 2-1/2 horizontal to 1 vertical.

They shall be designed to accommodate the equipment anticipated to be used for maintenance. Side slopes shall not be steeper than 6:1 when tillage/harvesting or other equipment will cross the waterway.

**Depth.** The minimum depth of a waterway that receives water from terraces, diversions, or other tributary channels shall be that required to keep runoff water at, or below the water surface design elevation at the junction with the waterway, when both are flowing at design depth (full flow).

Design depth shall be based on the maximum expected retardance for the final cover anticipated (vegetation condition, i.e. mowed versus unmowed) used to determine design velocity and waterway capacity.

**Drainage and Prolonged Surface Flow.** Designs for sites having prolonged surface flows, a high water table, or seepage problems shall include Subsurface Drains (606), Underground Outlets ( 620), rock/stone centered channels installed according to Lined Waterways or Outlet (468) practice standard, or other suitable measures such as water tolerant grasses (i.e. Prairie cordgrass) that are adapted to saturated conditions.

**Outlets.** All grassed waterways shall have a stable outlet with adequate capacity to prevent ponding, out of channel flow, or flooding damages. Rock/stone centered channels installed according to Lined Waterways or Outlet (468) practice standard can be utilized on the portion of the waterway channel necessary to provide a stable outlet. Outlets can include stable vegetated channels or ditches, grade-stabilization structure, woodland or grassland that is stable, flat cropland where channelized flow will not occur, or other suitable/stable outlets.

## MINIMUM WATERWAY DESIGN

Minimum waterway designs developed will vary for individual counties, soil types and slope ranges. Minimum waterway designs may be used when site conditions, drainage area, soils, slope, and other design considerations are verified on-site and on-site conditions are similar to the conditions used in the design.

Minimum waterway designs must meet or/exceed the design required when using the individual waterway design criteria. Documentation for minimum waterway designs must be available to ensure that individual waterway design criteria are met or exceeded.

## EPHEMERAL SHAPING

Ephemeral shaping may be used on drainage areas less than 7 acres where small ephemeral gullies are a problem. The ephemeral area shall be shaped to blend into the original topography and to define a waterway channel cross section. The cross section of this channel may be slightly irregular in shape, width, and depth. The following criteria shall also apply:

- Shaping shall begin a minimum of 20 feet upslope from the beginning of the ephemeral gully.
- Ephemeral shaping areas shall not be used as outlets for other constructed practices such as terraces, diversions, etc.
- Ephemeral shaping areas shall end at a stable outlet.
- Cross sections for ephemeral shaping areas shall be wide enough to ensure that surface runoff properly drains into the waterway and is safely conveyed to the next reach, but shall never less than 20 feet wide.
- Ephemeral shaping areas must be seeded to grass according to criteria in the vegetation section of this standard.

## VEGETATION

**Establishment.** Grassed waterways that will be planted, sprigged or sodded with grass shall be vegetated according to Critical Area Planting (342) practice standard and the following guidelines.

Grass will be planted as soon as conditions permit. When necessary to successfully establish grass cover crops, sodding, and/or mulching shall be utilized. Refer to Cover Crop (340), Mulching (484) and Critical Area Planting (342) practice standards for details on

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utilizing these practices. All measures required to stabilize waterway channels with grass cover will be installed based on the velocity criteria for individual waterway designs (based on the design velocity, soils, temporary/permanent cover, and waterway slope).

**Grass Mixtures.** Grasses species (those in Table 2 and other species not listed), and varieties must be adapted to the site (refer to Critical Area Seeding (342) practice standard and/or Section II Pastureland Interpretations, "Certified Perennial Varieties for Nebraska"). Sod-forming grasses shall constitute at least 70 percent of the total mixture.

Grass species selected for mixtures shall be compatible with vegetation management practices (timing and height of mowing, haying, incidental grazing, fertilizer, etc.) and herbicides that may enter the waterway. Most mixtures should contain both warm and cool season perennial grasses.

**Table 2 Grass species for waterway mixtures**

1/ Species	Non-sandy soils	Sandy soils	Poorly drained soils	Notes
<b>Native Cool Season Grasses:</b>				
<u>Canada wildrye</u>	0	0	X	S
<u>Virginia wildrye</u>	-	-	X	S
Western wheatgrass	X	X	X	HR
Thickspike wheatgrass	X	X	-	HR
<b>Warm season grasses</b>	<b>Non-sandy soils</b>	<b>Sandy soils</b>	<b>Poorly drained soils</b>	<b>Notes</b>
Big bluestem	X	0	-	S
2/ <u>Blue grama</u>	X	X	-	B
<u>Buffalograss</u>	X	X	-	HR

Sand bluestem	-	X	-	S
Indiangrass	X	-	-	S
Sideoats grama	X	X	-	S
2/ <u>Sand lovegrass</u>	-	X	0	B
<u>Switchgrass</u>	X	X	X	SB
Prairie cordgrass	-	-	X	HR
<b>Introduced Cool Season Grasses:</b>	<b>Non-sandy soils</b>	<b>Sandy soils</b>	<b>Poorly drained soils</b>	<b>Notes</b>
Intermediate wheatgrass	X	0	-	S
Pubescent wheatgrass	X	X	-	S
Creeping foxtail	X	-	X	HR
3/ Perennial ryegrass	X	0	0	SL, B
Smooth bromegrass	X	-	-	HR
2/ <u>Tall fescue</u>	X	-	0	B
Reed canarygrass (may or may not be native)	-	-	X	HR

X = Best suited

0 = Fair

- = Poor or not suited

B = Bunchgrass

HR = Highly Rhizomonous (strong sodforming)

S = Sodforming (not aggressive)

SB = Sodforming that grows in bunches

SL = Short lived

1/ Species in italics/underlined can make up no more than 25% individually and no more than 40% in total (in aggregate) of a mixture.

2/ Bunchgrass species can make up no more than 30% of a mixture (including other bunchgrass species not listed in this table).

3/ Only use Perennial ryegrass for short-term cover for erosion control. When using this grass species it shall be above and beyond the recommended seeding rate.

**Herbicide Tolerance.** Grasses and cover crops utilized must be adapted to herbicides that are likely to be applied across waterways and/or have the potential to drift or enter the waterway through runoff (herbicide use and application method shall be determined prior to recommending grass mixtures). Herbicide labels shall be checked to determine which grass species and/or cover crops are adapted to herbicides that are likely to enter the waterway.

When grass species tolerant to herbicides are not available, or measures to avoid the potential of herbicides entering waterways, are not practical, grassed waterways shall not be installed/recommended. Grass species (established) listed below have demonstrated a wide range of tolerance to many corn, sorghum, soybean and small grain herbicides (not including non-selective herbicides such as glyphosate).

- ◆ Western wheatgrass (tolerant to triazine and imidazolinone herbicides)
- ◆ Intermediate/Pubescent wheatgrass (tolerant to imidazolinone herbicides)
- ◆ All native warm season grasses (tolerant to triazine and imidazolinone herbicides)

## CONSIDERATIONS

Important wildlife habitat, such as woody cover or wetlands, should be avoided or protected if possible when siting the grassed waterway. Waterways serve as corridors for wildlife by connecting wildlife habitat areas ; e.g., riparian areas, wooded tracts and wetlands.

Temporary protection such as mulching, temporary cover or side dikes should be considered to enhance vegetation establishment. Side dikes may be constructed from earth fill, straw or hay bales or other acceptable material. The vegetation should be well established before side dikes or other temporary protection is removed and runoff permitted in the channel.

Grassed waterways should be constructed and established to perennial vegetation prior to terraces or other structural practices being built which will concentrate flow in the grassed waterway.

Consider adding Perennial ryegrass or a companion cover crop such as oats in addition to the normal grass mixture for short-term cover for erosion control (when soil moisture is not a concern).

Use irrigation water when available to promote germination and vegetation establishment.

Provide rock or other stable livestock and vehicular crossings as necessary to prevent damage to the waterway and its vegetation.

Consider constructing a wider and shallower waterway cross section will decrease flow velocity, which will help stabilize the waterway quicker, improve filtering and water quality benefits and wildlife habitat benefits.

Consider utilizing native forbs along with native grasses to maximize wildlife benefits. Avoid the use of aggressive species such as Smooth brome grass or Reed canarygrass when there is potential to invade adjacent grasslands.

Consider seeding odd areas to grass that are adjacent to grassed waterways by extending grass from the outside edge of the grassed waterway, so that all spraying, planting and tillage operations are perpendicular and short rows are eliminated.

## PLANS AND SPECIFICATIONS

Plans and specifications for grassed waterways and associated practices and measures shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose(s). Plans and specifications for grass

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establishment will be prepared that includes; seedbed preparation, pre and/or post herbicides/other methods of weed control, method depth and time of seeding, seed mixture species variety and rate, stabilizing cover crop, mulching, or mechanical means of stabilizing erosion, fertilizer, lime requirements and other applicable items.

### OPERATION AND MAINTENANCE

An operation and maintenance plan shall be provided to and reviewed with the landowner. The plan shall include the following items and others as appropriate. Refer to Nebraska Conservation Planning Sheet 3 "Grassed Waterways" and (412M) "Operation and Maintenance Plan for Grassed Waterways" for more information on operation and maintenance procedures.

A maintenance program shall be established to maintain waterway capacity, vegetative cover, and outlet stability. Vegetation damaged by machinery, herbicides, or erosion must be repaired promptly.

Seedings shall be protected from concentrated flow and grazing until vegetation is established. Sidedikes that are installed to temporarily divert runoff in order to protect waterways from concentrated flow erosion shall be removed promptly after vegetation is established.

Avoid damaging vegetation when spraying, tilling or performing other farming operations, and by excluding livestock whenever possible, especially during wet periods.

Inspect grassed waterways regularly, especially following heavy rains. Damaged areas shall be filled, compacted, and seeded immediately. Remove sediment deposits to maintain capacity of the grassed waterway.

Landowners should be advised to avoid applying non-labeled herbicides across waterways, especially when forbs are included in the seeding mixture. Avoid using waterways as turn-rows during tillage, spraying and cultivation operations. Prescribed burning and mowing may be appropriate, but should be conducted at times that will avoid peak nesting season and/or reduce winter cover.

Mow/hay or incidental graze waterways to maintain channel capacity and grade by reducing sediment deposition. The timing and height of mowing or incidental grazing should be compatible with the planned grass cover. Mowing low and late in the season will decrease the stand and vigor of warm season grasses in mixtures and increase cool season grasses. Mowing and harvesting of grasses shall be consistent with Forage Harvest Management (511) in order maintain the desired stand and vigor of grasses.

Control noxious weeds with the most appropriate method that will not destroy protective cover.

Do not use as a field road. Avoid crossing waterways with vehicles or heavy equipment when wet.

### REFERENCES

[Engineering Field Handbook \(EFH\) Part 650, Chapter 7 USDA NRCS](#)

[Agricultural Handbook 667, Stability Design of Grass-lined Open Channels Agricultural Research Service \(ARS\)](#)